The Science Teacher

DECEMBER

1945

Volume XII

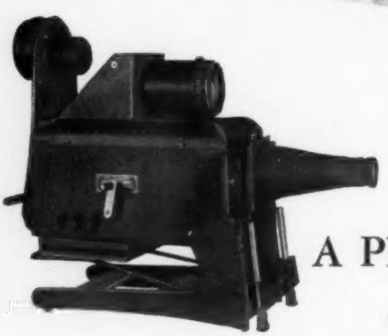
Number 4

Published
OCTOBER
DECEMBER
FEBRUARY
APRIL

AIRACOMET — FIRST AMERICAN JET-PROPELLED PLANE
(See Page 22) *Official Photo U. S. A. A. F.*

IN THIS ISSUE . . .

A National Service Journal



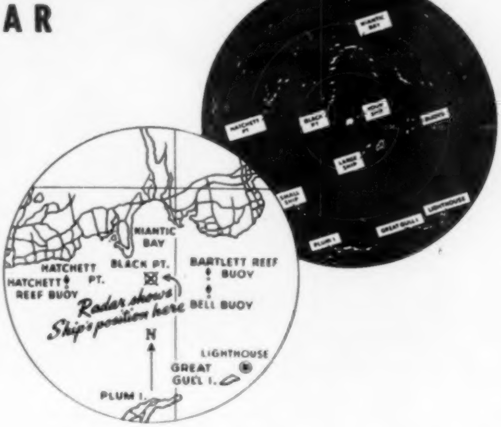
Science Shorts

ON SUBJECTS YOUR STUDENTS WILL ASK YOU ABOUT

RADAR

POTENT WEAPON against the Axis, radar did much to help the Allies win the war by quickly detecting the approach of the enemy at sea and in the air. The word radar itself comes from the descriptive phrase, "*ra*dio *d*etection *a*nd *r*anging." The big point about radar is that it can see farther than the eye can, even in the best visibility; and radar's ability to see is relatively unaffected by night, fog, smoke, or rain. In radar, unlike communications, the transmitter and the receiver are located at the same place, and more often than not have a common antenna. The transmitter sends out pulses of high-frequency waves, and between these intense bursts of energy the receiver is working and the signals it receives are the echoes of the powerful transmitted pulses from nearby objects.

RADAR ECHOES, in one application, are caused to draw a map on the face of a cathode ray tube. The radar operator could imagine himself suspended high above the set, looking down on the scene spread out below. No matter how many targets surround the radar set, each is indicated by a blob of light on the tube face—the distance of the blob from the center indicating the target's



range. The whole picture is there, as is shown in the drawing above—actual chart at left, radar picture at right.

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•

This advertisement is one of a series, designed as a service to teachers of question-asking boys and girls. *General Electric Co., Schenectady, N. Y.*

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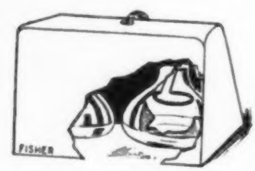

THE SCIENCE TEACHER

Official Journal of

National Science Teachers Association *of the* United States

A Scientific and Professional Association

Science teachers' organizations are invited to affiliate with the National Science Teachers Association. For information write to any officer.

The Science Teacher

201 NORTH SCHOOL ST.
NORMAL - ILLINOIS

A Service Journal for National, State and Regional Associations

Official Journal of

Illinois Association of Chemistry Teachers
Illinois Biology Teachers Association
Indiana High School Chemistry Teachers Association
Iowa Association of Science Teachers, Inc.
Texas Science Teachers Association

Entered as second-class matter January 30, 1940, at the post office at Normal, Illinois, under the Act of March 3, 1879.

Subscription rates: In the United States, $1.00 per year, or $1.75 for two years; in Canada, $1.25 per year, or $2.00 for two years.

The Science Teacher

VOLUME XII DECEMBER, 1945 NUMBER 4

Atomic Energy

CLARENCE CROSS

Illinois State Normal University Normal, Illinois

On August 6 an atomic bomb was dropped on Hiroshima. The effect of this bomb was so devastating that universal interest was aroused. Since August 6 many newspaper and magazine articles and several books have been written about "Atomic Energy".

The term "atomic energy" is somewhat of a misnomer. Atomic energy is involved in any chemical reaction. It has been utilized in every bomb since bombs were invented. A more descriptive term as applied to this bomb is "nuclear energy". However, the word "atomic" will no doubt stick and we shall continue to talk and write of the atomic energy which is released by the atomic bomb.

The first evidence of nuclear energy came with the discovery of radioactivity in 1896, although it was not then recognized as nuclear energy. However, later work with radioactive elements showed that enormous quantities of energy were involved and that this energy originated in the nucleus of the atom.

In 1905, as a result of his theory of relativity, Einstein announced the idea that mass might be converted into energy. The equation he derived for this is $E = MC^2$ in which E is energy in ergs, M is mass in grams, and C is the velocity of light in centimeters per second. This equation shows that the "Law of Conservation of Matter" and the "Law of Conservation of Energy" are obsolete. However, this remained only a theoretical idea for twenty-five years. The decade from 1930 to 1940 saw many experimental verifications of this equation.

The next important step in the development of getting energy from the nucleus of the atom came in 1919. Sir Ernest Rutherford discovered that when nitrogen was bombarded with high speed alpha particles from Radium C', very high energy hydrogen particles were obtained. Later work showed the equation for this action to be,

$${}_7N^{14} + {}_2\alpha^4 \rightarrow {}_8O^{17} + {}_1H^1$$

The superscripts represent the atomic mass and the subscripts the atomic number. This action had three unusual features for this period.

1. The H particle which came from the nitrogen had several times as much energy as the alpha particle which knocked it out.
2. No radioactive element up to this period had emitted an H particle. Radioactive emissions had consisted only of alpha and beta particles and gamma rays.
3. Oxygen was formed. This is the first case of artificial transmutation of matter.

By 1929, determined efforts were being made to smash the atom. It was in 1929 that many of the atom smashing machines, such as the cyclotron and the Van de Graaff generator were conceived.

The next important step in the development of the atomic bomb came in 1932 with the discovery and recognition of the neutron. The neutron was discovered in 1930 by two German physicists, Bothe and Becker. They reported that a very penetrating radiation was emitted by beryllium when bombarded with alpha particles. They regarded this as a very penetrating electromagnetic radiation. The true nature of this radiation was finally recognized in 1932 by J. Chadwick in England.

The neutron has proved to be a powerful atom smashing weapon. Since it carries no

charge it is not repelled by the nucleus of the atom. Thus it is not difficult for a neutron to penetrate the nucleus. In fact, the neutron has proved to be much more effective in penetrating the nucleus of some atoms if its velocity is comparable to the thermal velocity of the molecules.

The years following 1932 proved to be fruitful years for nuclear physics. Dr. Enrico Fermi of Italy was one of the leading physicists in these nuclear studies. He conceived the idea of using the neutron as a bullet and it was his work that showed the slow neutron to be so effective in penetrating the atomic nucleus.

By 1935, as a result of neutron bombardment, nearly every element in the periodic table had been made radioactive. Practically every particle known to modern physics has been observed to come from the nucleus of these radioactive elements. The most common reaction, however, is for the unstable nucleus to emit an electron. Thus it becomes an isotope of the element next above it in the periodic table. This is the method by which elements No. 93 and No. 94 are created. These reactions are indicated as follows:

$${}_{92}U^{238} + {}_{0}N^{1} \rightarrow {}_{92}U^{239} \rightarrow {}_{93}Np^{239} + {}_{-1}e^{0}$$

Np is the chemical symbol for the new element, neptunium, No. 93. The half life period of neptunium has been found to be about 2.3 days. Neptunium decays with the emission of another electron, thus:

$$Np^{239} \rightarrow {}_{94}Pu^{239} + {}_{-1}e^{0}$$

Pu is the chemical symbol for plutonium which is element No. 94.

It is true that not all atoms become radioactive with the capture of a neutron. Some remain stable. The additional neutron in the nucleus of the atom merely makes it an isotope of the original element. A table in "Reviews of Modern Physics", December 30, 1940 lists 278 stable isotopes and over 300 artificially radioactive ones. Thus we now know about 600 structurally different nuclei.

The final step in the scientific background of the atomic bomb came from work done by Hahn, Strassman and Meitner in Germany. They found barium present after uranium had been bombarded with neutrons. The results of this work were published early in January, 1939, without any attempt being made to explain them. In the meantime Dr. Meitner, who was not a "pure Aryan" had been expelled from Germany by Hitler. Upon arriving in Stockholm, she concluded that the barium had been formed by splitting the uranium atom—a process that soon became known as "nuclear fission". She informed her nephew Dr. O. R. Frisch, who had also been driven from Germany, of this conclusion. Dr. Frisch was then working with his father-in-law, Neils Bohr of Copenhagen. When this information was given to Frisch Bohr was all ready to embark for a visit to the United States. He arrived at Princeton, N. J. on January 16, 1939, and immediately informed the physics staff at Princeton University of the work done in Germany. This information soon spread to Dr. E. Fermi who had been forced to leave Italy and was then at Columbia University. On January 26 a conference on theoretical physics was held in Washington, D. C. Bohr and Fermi discussed the problem of fission at this conference. Before the conference ended four laboratories in this country had repeated this experiment on uranium fission.

Up to this time, all atom smashing experiments had resulted in only minor changes in the nucleus of the bombarded atom. The alpha particle was the largest fragment that had been chipped from the nucleus of any atom.

Theoretical considerations indicated that enormous energy should be released when the uranium atom broke apart—ten to twenty times as much energy as had been released by the atom in previous transformations were indicated. Practically all of this could be accounted for by an effect known as the "packing fraction". A check on isotope masses shows that few of the atoms have an exact whole number mass. For example, the H^1 atom, (the superscript indicates the number of particles in the nucleus) has a mass of 1.00813 and the He^4 atom has a mass of 4.0039. This mass is less than four times that of the H^1 atom.

Atoms in the periodic table below neon, atomic number 10, have masses slightly larger than the number of particles (protons and neutrons) which they contain. In other words, atoms below number 10 have positive pack-

ing fractions. Of course, O^{16} has a mass of exactly 16, since 1/16 of this atom is taken as the unit mass. For H^1 it is plus 0.00813, for He^4 it is plus 0.000975. From neon to platinum, number 78 the packing fraction is generally negative. For example, Kr^{84} has a mass of 83.928 or a negative packing fraction of 0.000857. This is found by dividing the mass 83.928 by the mass number 84 and finding how much the quotient differs from unity. For atoms above number 78 the packing fraction again becomes positive.

For U^{235} the atomic mass is 235.084. Hence the packing fraction is plus 0.000357. For example, when the uranium atom is broken down to krypton and barium, the mass of the particles which make up the nucleus must shrink by about 0.0011 mass units. (Ba^{138} has a negative packing fraction of 0.00064 and Kr^{84} a negative fraction of 0.00086. The average of these with the positive 0.000357 fraction for uranium gives a mass change of approximately 0.0011 mass units.

If this shrinkage is taken as 0.0011 per mass unit, then for 235 mass units the shrinkage would be 235 x 0.0011, or 0.2585 mass units. A mass unit is 1/16 of O^{16} or 1.659×10^{-24} grams. Hence $1.659 \times 10^{-24} \times 0.2585 = 4.2885 \times 10^{-25}$ grams which must be converted into energy when an atom of U^{235} is split. This may be expressed in ergs by use of Einstein's equation E equals MC^2. E equals $4.2885 \times 10^{-25} \times 9 \times 10^{20} = 3.86 \times 10^{-4}$ ergs.

In expressing the energy derived from the individual atom, one million θ electron volts is frequently used as the unit.

$$\text{The m. e. v.} = \frac{10^6}{300} \times 4.8 \times 10^{-10} = 1.6 \times 10^{-6}$$

ergs

Therefore, the uranium atom gives,

$$\frac{3.86 \times 10^{-4}}{1.6 \times 10^{-6}} = 241. \text{ m. e. v.}$$

Experimental tests show that the particles of fission have around 200 m. e. v. of energy.

The second source from which energy may be derived is explained as follows: The nucleus of each atom is considered to contain sufficient protons to give it a charge equal to its atomic number and the rest of the atomic base is made up of neutrons. If the atomic number is represented by N and atomic mass by A, the neutrons in each nucleus is equal to A-N. When this system is applied to the atoms of the atomic chart, it is found that the percentage of neutrons increases with an increase in atomic number. For example, ${}_{92}U^{235}$ has 235—92, or 143 neutrons; and ${}_{56}Ba^{138}$ has 138—56, or 82 neutrons. ${}_{36}Kr^{84}$ has 84—36, or 48.

Thus while the number of protons (36 plus 56) is 92 the number of neutrons (48 plus 82) is 130, or 13 less than ${}_{92}U^{235}$ originally had. These examples were used because uranium fission has been found to produce these atoms some of the time. Almost all of the elements with atomic numbers between 32 and 65 have been found as a result of this fission. However, no two of them whose protons add up to 92 will have enough neutrons to add up to 143. If the heaviest isotopes for each element, from atomic number 30 to number 62, be taken in pairs so that the sum of the atomic numbers, or protons, equals 92, the maximum number of neutrons obtained for any pair is 136. Thus neutrons must be released.

It is this theory of excess neutrons that led Fermi to suggest the possibility of a chain reaction. The prerequisite for a chain reaction being that each atom which undergoes fission must furnish the energy to produce another fission. If each fission atom does less than this the action will die out. If it does more than this the action will build up and attain explosive proportions.

This would seem to indicate that uranium either should explode automatically or else that it could not be made to explode. The answer to this is found in the uranium isotopes. Natural uranium contains 0.006 percent of U-234, about 0.71 percent U-235 and 99.284 percent U-238. It is the U-235 atom thas undergoes fission; the U-238 will capture certain speed neutrons without fission. Then through electron emissions, as previously outlined, it changes to plutonium.

Hence, the secret of getting an explosion from the U-235 atom was to get it in sufficient concentration. This meant that it must be segregated from the U-238 atom. Since

Continued on Page 42

Editorial and News

Who is Going to Improve Science Teaching?

DR. PHILIP G. JOHNSON
President of National Science Teachers Association
Cornell University Ithaca, New York

There is a crying need to improve and expand science teaching." "Science teaching is 25 years behind the times." "Science teaching has been tried and found wanting." So say the critics. As science teachers we would agree that all is not well with science teaching but we may have reasons for this condition which are quite different from those of our critics. Furthermore, we may be of a disposition to resist the efforts of the expeditors who give widespread publicity to the defects of science teaching without knowing very much about the factors involved in the actual teaching situations. Who is going to improve science teaching?

WE MAY find a helpful hint if we look at some other groups. Who does the most to upgrade and improve conditions and practices in the legal profession? Who does the most to maintain high standards in the medical profession? Who does the most to bring about improvements in the various trades? We have to admit that these groups are well organized and work for improvements within their own organization. They also work through other groups whose understanding and assistance must be obtained in order to improve standards and conditions. We, the science teachers of the United States, can improve and expand science teaching. We, the science teachers, can improve conditions for science teaching. We, the science teachers, can establish worthy standards and work for their acceptance. We, the science teachers, can work with leaders in other professions and secure their sympathetic understanding and support for better and more science teaching. We can, but are we willing to work in this area and do we know how to do it?

No one person knows all the answers. No one organization has all the informed and farsighted science teachers. No one teacher is a master of all the techniques. Nevertheless, each teacher has one or more ideas which are truly good. As we meet and share ideas we always get a few of these good ideas and our teaching becomes better. But often there are obstacles to good science teaching which the teacher alone cannot surmount. Sometimes the obstacle can be removed by a talk with the principal or the superintendent. More often the obstacle will yield if the several science teachers concerned can make a joint appeal for action. Now and then all the science teachers in a county, city or state need to work together to remove an obstacle. Science teaching can be improved and expanded if we, the science teachers, will define the trouble, push for a solution, and keep pushing while maintaining a friendly yet determined composure. As science teachers we need to be organized if we are to be a force for the improvement and expansion of science teaching. We need to be organized locally, regionally and nationally. We need to work together.

WE MAY now drive and travel to conferences and conventions. We can get together and share ideas. We can organize and develop a helpful program of action. The sample constitution which follows is a pattern. You can cut, slice and revise to suit your needs. Plan a constructive meeting. Invite in your co-workers. Talk about plans for the future. Get organized for action — and affiliate with the National Science Teachers Association so that both organizations may grow in strength and influence for good.

Sample Constitution

For a Local Association of Science Teachers

Article I. Name and Purposes:

1. This organization shall be known as the .... Science Teachers Association.

2. The .... Science Teachers Association shall be an affiliate of the National Science Teachers Association.

3. The terms "local association" herein-

after used shall refer to the .... Science Teachers Association, while "National Association" shall refer to the National Science Teachers Association.

4. The purposes of the local association shall be as follows: (a) to promote personal and group cooperation of science teachers on problems related to science teaching; (b) to cooperate in providing for national, sectional, state, and local conferences on science teaching; (c) to prepare and distribute articles, reports, and classroom materials which are an aid to science teachers; (d) to encourage research, investigations, and experimentation in science education; (e) to cooperate with the National Association in formulating plans and working out projects which advance the quality of science teaching and which promote a more widespread acceptance of science as a subject worthy of serious study in elementary and secondary schools.

Article II. Memberships, Dues, Meetings:

1. Any person in sympathy with one or more of the purposes of the local association may become a member upon the payment of the annual dues.

2. The membership year shall be from September 1 to August 31.

3. There shall be two classes of members known as (a) *active members*, (b) *associate members*. Active membership is for full-time science teachers and others who wish to be informed concerning national developments. This class of membership will include membership in the national association. Associate membership is for part-time science teachers and it is a local membership only.

4. The annual dues shall be determined by the *guiding committee*. Until this committee shall make a change, the dues shall be $1.50 per year for active members, and 50c for associate members.

5. The payment of active membership dues shall entitle a member to all the publications of the national association: the official magazine, the yearbook, and such other publications and reports as the board of directors of the national association may authorize. Each active member is entitled to attend all meetings sponsored directly or indirectly by the national association, to vote on national issues, and to hold a national office. Furthermore, active members receive all announcements and reports of the local association. Associate members receive all announcements and reports and are invited to attend, vote, and hold office only in the local association.

6. Meetings for the election of officers in the local association and for other major business, shall be conducted at regular meetings which shall be held on the .... of each month of the school year from October to May. The time and place shall be as determined by the *guiding committee*.

7. The local association shall cooperate with the national association in planning conferences and other meetings for science teachers from areas larger than the local association.

Article III. Organization, Officers, Duties:

1. The local association shall consist of the active and associate members.

2. The *guiding committee* of the local association shall consist of fifteen science teachers who represent the diverse interests of all the local science teachers. The members of this committee shall serve for three years and their terms shall be so arranged that five new members are elected each year. Vacancies on this committee may be filled by appointment or election. The officers of the local association shall be members of the *guiding committee* during their terms of office.

3. The officers of the local organization shall consist of a president, two vice-presidents, and a secretary-treasurer or a secretary and a treasurer. These officers shall comprise the executive committee. Election shall be from a slate of officers proposed by a nominating committee which was approved by the guiding committee and appointed by the president. Nominations may also be made from the floor. Election of officers shall take place at the April or May meeting of the local association.

4. Officers shall begin their duties on August 1st following their election and shall hold office for one year. They shall be eligible for re-election. The officers of the local association shall be the officers of the guiding committee.

5. The guiding committee shall have the power to recommend membership dues, to plan series of meetings, to appoint committees and review their reports and to cooperate with the national association on matters pertaining to the local association.

6. The president shall have general charge of the affairs of the local association and he shall be the chairman of the guiding commitee and the executive committee. With the approval of the guiding committee, he shall appoint all committees necessary for the welfare of the local association. *Continued on Page 40*

This and That

NORMAN R. D. JONES
Vice President and Membership Chairman

100% Schools

LaGrange, Illinois High School.

Laramie, Wyoming High School.

Lansdowne Jr. High School, East St. Louis, Illinois.

Information Please

Mr. Leo J. Fitzpatrick, Brockton High School, Brockton 19, Mass., is Chairman of our Professional Relations Committee. He needs the help of every State Director and member. Please co-operate with him by sending him the names of all science organizations in your state. If you can do so, send him the names of all the officers of these organizations also. It will be very sincerely appreciated, and you will then have done your bit toward enlarging our group of affiliates. Don't delay, do it right now while it's on your mind.

Deceased

Miss Ada Weckel, Oak Park and River Forest (Illinois) H. S.—July 10, 1945.

Miss Nettie M. Cook, Spokane, Washington—September 1, 1945.

New Directors

Mr. I. E. Blume, 61 South Remington Road, Bexley-Columbus 9, Ohio.

Mr. Donald Cole, Sup't of Schools, Willow Creek, Montana.

Mr. Roland Dietmeier, Sup't Consolidated Schools, Wilsall, Montana.

Mr. Harwood Gordon, 8448 Madison Ave., South Gate, California.

Mr. Rollin Enfield, Pamona Junior College, Pamona, California.

Puerto Rico S. T. A.

The Puerto Rico Science Teachers Association, a N. S. T. A. Affiliate, recently sent in 71 memberships, 46 of which were new members and 25 (of last year's 52) renewals, stating that more would be sent in the near future.

In regard to the activities of this group on legislation No. S 1316: They have contacted a member of the P. R. House of Representatives and since he had free use of the Insular Telegraph, telegrams were sent to all their high schools, to the Insular Senate and leading newspapers in Puerto Rico. They in turn sent air mail letters or cablegrams to the Senate Committee on Education and Labor, in behalf of 1316.

Returned Service Men Attitude

Mr. William Barish, 5913 Alma St., Philadelphia 24, Pa. expressed the attitude found in several letters, "Sorry my dues are late, I was only recently discharged from the army and, *of course*, I wish to renew my membership in the National Association."

Slogan for Year

Each member secure at least 1 new member. Have you done so?

Miss Lowe Kinkade, 42 Taylor St., Kingston, New York writes a typical letter in response to this: I am forwarding not only my dues to N. S. T. A. but that of a new member, Mr. Warren A. Russell, who teaches General Science in Myron J. Michael School, here.

Mr. Worthy C. Kanarr, 1821 W. Oakes, Tacoma 6, Washington, asked for more blanks (than the 2 sent) so that he could secure more members.

News

Dr. N. Bayard Green (West Virginia State Director) spoke before the Eastern Kentucky Science Teachers Group on Friday, November 9th.

Mr. E. Y. Danner has been appointed to the newly created office of Director of Science for the Seattle Public Schools. They are developing a course of study from the kindergarten through the 12th year. Miss Dela J. Patch has been appointed as assistant Director.

Dr. Howard H. Michand is now Assistant Professor in Conservation at Purdue University working on a program for Conservation education for Indiana schools.

Mr. Arthur M. Mason formerly of Cottage Grove, Oregon is now Principal of the Union High School at Harrisburg, Oregon.

Miss Evelyn Cole of Fort Payne, Alabama is now teaching in Greensboro College, Greensboro, N. C.

Dr. Paul E. Blackwood is now at Ohio State University, Columbus, Ohio.

Miss Betty Lockwood is working on her Doctor's Degree at the Harvard School of Public Health.

New Project

N. S. T. A. has been awarded a new Consumer Education project by the National Association of Secondary School Principals to make a study of Commercial Educational Materials in Science such as charts, models, booklets, exhibit materials, etc., at the various school levels.

As is the policy of N. S. T. A. whenever possible, a cooperative meeting on this project was held with the Central Association of Science and Mathematics Teachers on Friday evening, November 23rd with Dr. Charlotte Grant, Oak Park (Illinois) High School, Miss Martha Pelikan, Ass't. Principal, Tremont Junior High School, Cleveland, Ohio, and Mr. David Aptekar, Mackenzie High School, Detroit, Michigan, presenting papers and leading the discussion.

N. S. T. A. collaborated with Eastern Science Groups at the Annual Conference of the Middle States Science Teachers Association held at the Hotel Pennsylvania, New York City, November 23 and 24.

Outside U. S.

Mr. W. Ashurst, Head of the Physics Department, Epson College, Surrey, England, and Secretary of the Science Masters' Association recently wrote for membership information. He stated he is very interested in learning of our work in the States.

Mr. Roy W. Stanhope, Murillumbah High School, New South Wales,, Australia, also recently requested similar information.

N. S. T. A. members are also found in Haiti, Puerto Rico, Hawaii, and England.

Affiliated Organizations Meetings

Many affiliated organizations have had their early fall meeting with excellent results, especially, if the fine number of memberships received can be a criterion.

Change of Address

Mr. George Leise to Berryville, Ark.; Mr. Oliver F. Clarke to Stockton, Calif.; Mr. M. Van Wynen to Berkeley, Calif.; Miss Blanche E. Brown to New Haven, Conn.; Mr. Edwin C. Miller to Waterbury, Conn.; Mr. John C. Willard to Wheaton College Academy, Wheaton, Illinois; Miss Gertha Stark to Davenport, Iowa; Mr. James L. Peyton to Leeco, Kentucky; Mr. Albert Munk to Whitmore Lake, Mich.; Miss Jane Johnston to Moorhead, Minn.; Mr. Robert Molkenbar to St. Paul, Minn.; Rex Congers to University City, Mo.; Miss Lorraine B. Cushman to Bolton Landing, N. Y.; Miss Mildred J. Pangburn to Altamont, N. Y.; Mr. Alvin La Vine to Velva, N. D.; Mr. Robert W. Lawrence to Corvallis, Oregon; Mr. Horace Merriman to Chelan, Wash.; Miss Louisa Pike to North Bend, Wash.

A national meeting of the N. S. T. A. is being planned for St. Louis, March 28-31. Cooperating in this meeting are the A. A. A. S. Cooperative Committee, on Science Teaching, the National Association of Biology Teachers, Nature Study Society, and the National Mathematics group.

The Consumer Science Report has now been published and is being mailed to all members.

A new project committee met in Washington, D. C. December 7-8.

The following are members of the 1945 Yearbook committee:

Dr. Maurice U. Ames, Science Supervisor, Board of Education of City of New York.

John G. Hogg, Phillips Exeter Academy, Exeter, New Hampshire.

Dr. Dwight E. Sollberger, State Teachers College, Indiana, Pennsylvania, Chairman.

The Yearbook Committee was assisted by the following members of the Cooperative Committee on Science Teaching:

Dr. K. Lark-Horovitz, Purdue University, Lafayette, Indiana.

Dr. G. P. Cahoon, Department of Education, Ohio State University, Columbus, Ohio.

Additional copies of this Yearbook may be secured from the National Science Teachers Association, 1201 Sixteenth Street, N. W., Washington 6, D. C. Price \$.50.

A Green Light For Our Science Act

HANOR A. WEBB

George Peabody College for Teachers **Nashville, Tennessee**

THE NATIONAL Education Association has given unqualified approval of the High School Science Education Act of 1945, sponsored by the National Science Teachers Association.

The Legislative Commission of the N.E.A., meeting in Washington the last week in September, considered Senate Bill 1316, relating to high school science. This was introduced by Senator Thomas of Utah on July 26, 1945, and referred to the Committee on Education and Labor of the Senate. At this writing the Bill is still in the Committee's files.

A summary of the Science Education Act of 1945 is presented in THE SCIENCE TEACHER for October, pages 16 and 17.

The National Education Association has not failed to include S. 1316 — The High School Science Education Act of 1945 — in its widely circulated current news letters. *NEA Leaders News Letter No. 46* of September 12, 1945, lists S. 1316 among other bills relating to science. *Legislative News Flash* of October 19, 1945, contains the following paragraph:

During its September meeting, the NEA Legislative Commission recorded itself as favorable to federal subsidization of scientific research and will accordingly place its views to that effect before the Senate committee now engaged in holding hearings on the pending legislation. The Commission also approved S. 1316, a bill which proposes federal appropriations beginning with $4,000,000 for the fiscal year ending June 30, 1946, gradually increasing to $20,000,000 for the fiscal year ending June 30, 1950, to strengthen science education in the public secondary schools of the nation.

AFTER THE Legislative Commission had finished its reports, the following letter was written by Mr. R. B. Marston, Director, Legislative-Federal Relations Division of the N. E. A.:

NATIONAL EDUCATION ASSOCIATION
OF THE UNITED STATES
1201 Sixteeneth Street, N. W.,
Washington 6, D. C.
October 22, 1945

Dr. Hanor A. Webb
Chairman, Legislative Committee
National Science Teachers Association
George Peabody College for Teachers
Nashville, Tennessee

Dear Doctober Webb:

On behalf of the NEA Legislative Commission, I wish to express appreciation for your appearance before that body during its recent Washington meeting, September 27, 1945. Your very fine and eminently fair presentation of the High School Education Act of 1945 enabled the Commission to express unanimous Approval of the Act.

The Commission is actively interested in promoting the cause of education in all subject fields, including science education. At this time the Commission is concentrating its effort upon securing the enactment of S. 181-H.R. 1296, a general federal aid bill which provides benefits for not only science but for mathematics, the social studies, English, and all other subjects found in the curriculum of our elementary and secondary schools. The extent to which the N. E. A. Legislative-Federal Relations Division can actively promote the High School Science Education Act will be determined by the demands of the general federal aid bills, S. 181-H.R. 1296.

We hope that the members of the National Science Teachers Association will closely examine S. 181-H.R. 1296 which we believe is a sound underpinning for all specialized education. It is in this connection to be noted that there is considerable conformity between the purposes and benefits of S 181 and the High School Science Education Act of 1945, with the exception that S. 181 is inclusive of the whole area of elementary and secondary education.

With every good wish, and thanking you again for your splendid presentation, I remain

Sincerely yours,
(Signed) R. B. Marston, Director
Legislative-Federal Relations Division

RBM:kg

The "Over-All" Bill

THE BILL before Congress to which Mr. Marston refers — S. 181 — was introduced in the Senate on January 10, 1945, by Sena-

tor Thomas of Utah. It is identical with House Resolution 1296. It is known officially as the "Educational Finance Act of 1945," but is usually referred to as "Federal Aid to Education." Mr. Marston concisely describes the purposes of this legislation in the second paragraph of his letter.

The third paragraph written by Mr. Marston is an earnest request to science teachers to inform themselves as to the provisions of the broad federal aid bill. Copies of S. 181-H.R. 1296 may be obtained by writing to Mr. Marston.

In a personal letter Mr. Marston wrote as follows:

The Commission is convinced, I am sure, that the general aid bill will provide substantial benefits to high school science education, as well as to other types of high school education — language, mathematics, social studies, and the like. I like very much Dr. Johnson's suggestion that S. 181 be carefully examined, and that it be included in your report to your Legislative Committee. Personally, I wish very much that questions of this kind might become the subject of extensive and conclusive discussions. I think it would be very much worthwhile for the entire teaching profession.

The comments of Dr. Johnson, president of the National Science Teachers Association, to which Mr. Marston refers, were in a personal letter, as follows:

It is highly desirable that we give support to the general aid bill, for which the NEA has worked so long and so hard. It would be selfish for us to do otherwise, for we know that there is more to education than science. . . . It will be well to see just how science education may be helped by the general bill, and make this clear to our members. I suggest that you study this particular item.

THE ACTUAL administration of both the Educational Finance Act and the High School Science Education Act is left to State education authorities in the provisions of the bills. In the general aid bill (S. 181) there are no specifications as to distribution of aid according to grade levels, or subjects. If this bill passes, it will be up to science teachers to present their cause to their local school boards, and to the State Board of Education, in obtaining their proportion of benefits. Much can be said in favor of this obligation. If science teachers are not alert and progressive, what do they deserve?

The high school science aid bill (S. 1316) makes specific appropriations for definite grade levels and subjects. The strongest argument for this is the future need of our nation for a host of trained scientists and technologists. This is absolutely essential for prosperity and defense. If Congress implements the Bush Report —*Science, the Endless Frontier*—with appropriations for research and scholarships (6,000 per year), it is imperative that high school science be strengthened. As this is written, Congress is holding hearings on the Kilgore Bill, the Magnuson Bill, and others.

No other subject in the curriculum will require such intensive and extensive improvement as high school science, if proper foundations are to be given for the trainees, and workers, in the university and research laboratories that will be in operation—according to every wise prediction — five and ten years hence. This is well expressed by Prof. Joseph Singerman in "Opportunity Knocks for Science Teachers," THE SCIENCE TEACHER, October, 1945, page 24 and following.

What Do We Do Now?

THE "green light" is always a "go-ahead" signal—a call for more power, and accelerated action. The Educational Finance Act, (S. 181) and the High School Science Education Act (S. 1316) are expressions of belief, by tens of thousands, that the inequalities of educational opportunity throughout our land may best be remedied by financial aid from the Federal Government. Our people live, work, travel anywhere in our broad country without reference to State boundaries. Training for nation-wide citizenship justifies nation-wide support of education. It is believed that wise safeguards against centralized administration have been included in each Act.

These ideas are the convictions of many. There are objectors, to be sure—and those who oppose the broad general aid to education will also speak against aid to science.

Every earnest science teacher who accepts the leadership of the National Education Association, and the National Science Teachers

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A Foot Rule for Judging Science Teachers

WILLIAM GOULD VINAL, "Cap'n Bill"

Massachusetts State College — Amherst, Massachusetts

THE YARDSTICK for a healthy individual is made up of such definite units as temperature, pulse, heart beat, blood pressure, digestion, sound teeth, clear skin, and sparkling eyes. If there is a health problem, the technician applies the yardstick, diagnoses the cause, and prescribes the remedy.

The measuring stick for good science teaching is not so apparent and yet every science teacher should have some kind of guage. The writer ventures to suggest twelve important units for measuring a science teacher. The reader will recognize the difficulty of reducing a highly technical procedure to a set of simple "do's". To clarify the meaning many "don't's" have to be included. It is the writer's experience that these rules cannot be disregarded with impunity. The science teacher who does not agree might get fun out of whittling his own foot rule.

1. *Is the science teacher a guide?* Education comes from the Latin, e meaning out and ducere to lead. It doesn't mean the pouring in of facts until the victim reaches the saturation point nor is it a period of regurgitation under the name of "hour examination." Such a procedure has the odor of totalitarianism. Prescribed procedures can be handled efficiently by a fuhrer or by a nurse maid. In this military age it is more important than ever that youth be self-reliant and self-independent in exploring, arranging data, and weighing evidence. There should be no hesitation when choosing between scientific independence and mass emotionalism. The science teacher should be an individual who has the capacity to put students on their own endeavors and the skill to guide them in their discoveries.

2. *Is the science teacher a leader?* The old squib that a specialist is a person who knows more and more about less and less applies to both scientists and teachers. Take botany, for example. The botanist (to say nothing of naturalists) is practically extinct. There are bacteriologists, mycologists, plant physiologists, taxonomists on angiosperms, plant pathologists, and so on. A mycologist and a teacher of mycology are quite different species. The first may practice in his ghetto. The second may have a job but hate people. Either may have gone up a narrowing canyon to the point of becoming dessicated. If students are free individuals without threat or coercion of any kind (such as an examination), how many will follow the over-specialized teacher? The real test is—how many followers can the science teacher get on a Sunday afternoon hike or a canoe-paddle up-river? Leadership implies followership.

3. *Does the science teacher present an offering of experience?* Is he a member of the old school of "parroting" or does he practice as well as believe that pupils learn by "doing?" A subject-centered course is apt to have one textbook. It is referred to as "*the textbook*". The author may have been dead for 10 or 20 years. A text-booked curriculum under drill sergeants is the totalitarian method. They do not want the students to have ideas for the *book is right*. Books in a democracy are a means to an end. A student-centered course has a good reference library. It is more important to experience science and omit books than to study books and never experience science. A purposeful expedition to timber line and the parroting of "Mein Kampf" have different values. A science curriculum should be an experience curriculum. It means a program of scientific procedure and not blind servitude.

4. *Is the science teacher socially adjusted?* Youth who believe that science teachers are a privileged class where one may escape poverty and trouble are already defeated as leaders. It is dangerous if not insolent to assume that science teachers are supermen or an elite guard and that all others are subordinates. Does the science teacher believe that any racial group is a chosen people? Does the science teacher believe that everything else except botany or airplanes, or Diesel engines are "sappy" Does the science teacher consider his ilk as "intellectuals" and all others as the

common herd? Does the science teacher live in a world of ideals or in a world of reality? If the science teacher does not *think and act* science in community terms, as well as in world terms, he is practicing Shintoism.

5. *Has the science teacher been broadly trained?* Is he one that teaches science because it is functional or because he believes in the efficacy of mental discipline? What has he done in the way of travel? In camping? In agriculture? In industry? In community service? In scouting? In outdoor cookery? In recreation? In woods, fields, and streams? In music, drama, or hand craft? As a leader, what would he do when two girls started to pull each other's hair? All of these activities call for scientific skills and techniques. Efficient science teaching really means broad training.

6. *Does the science teacher use the group process?* The lecture method to a large gathering is similar to the exhorting of a dictator. It is imperialistic. Free discussion is the way of a cooperative democracy. Is the science teacher's program a regimented world of mechanized lectures, assigned experiments, words drills, and the memorizing of skeletal parts, or is the program planned to allow development of group interests? Is there cooperative freedom or is procedure on the Nazi basis that right is might ("do it or flunk")? If the science teacher runs mass activities he is doing it on the factory plan. Science flourishes best where there is complete opportunity and freedom of spirit.

7. *Is the science teacher for the sovereignty of the individual* or is he casting students in the same mold (and taking pride in the total annual output). Students may find their own good qualities in raising a geranium, in befriending a toad, in breeding pigeons, in making a model airplane, in sailing a boat or in forest survival. Is there opportunitw for individual choice, self-direction, self-government, and self-adjustment or does every individual conform to the same pattern? A simple accomplishment may give the feeling of inner ability. A student emerging from a science penthouse without having discovered anything is poor. One of the grass roots of science teaching is creative living rather than robot servitude.

8. *Does the science teacher use the outdoors?* Even science teachers can rationalize. The "specialist" believes that nature viewed as a whole would be too distracting. The textbook, "drill-sergeant" does not have time. The "elite" science teacher knows that the educative process is something for the school (i.e. a building; maybe laboratories). The "pure" science teacher would find too much that he did not know. The "totalitarian" science teacher must use any spare time for more "goose-stepping." How in the world could a science teacher handle forty individuals? There is auto-insurance, traffic laws, labor laws, unfavorable weather, sickness, yea a thousand excuses for the science teacher who would be delivered from such worldly practices. The science teacher in a democracy will, at least, give students an opportunity to choose the outdoors.

9. *Does the science teacher keep his mind flexible?* Does he read professional magazines and new books? Does he attend institutes and lectures? Does he attend (or take part in) professional meetings? Is he interested in progressive education? Does he keep abreast of discoveries in meteorology, in sanitation, in aviation, and in other fields of scientific progress?

10. *Does the science teacher recognize the value of science for leisure time?* A science teacher may believe in leisure time pursuits but not do anything about it. What science hobbies does he have? Does he offer the opportunity to gain satisfactions through "homesteading" science? What science hobbies does he encourage among students? What science clubs does he sponsor? Is membership forced? Are they really clubs with freedom of assembly, program, speech, and press? The writer does not place most Junior High science clubs in the realm of democratic procedure. Does the science teacher stimulate 5 per cent of his students to scientific growth throughout life or are they "educated" at the end of the course?

11. *Is the science teacher a crusader for science?* What does he do about *nature's laws?* Is conservation just another subject or is it a program of activity? Is he fond of creative writing? Public lectures? Public services in science? Specifically, how does he help his

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The Teaching of Chemical Arithmetic

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IN CHOOSING a method to be used in teaching the solution of numerical problems in general chemistry, it is necessary to consider the principal objectives to be attained by teaching such problems. Shall we necessarily select the method which, in the hands of the students, will give the correct answer most often in his early attempts? Can there be a more important objective than the correct answer?

This paper is based upon the thesis that while relatively few of our beginning students will ever need to solve chemical problems after they leave school, every one would benefit by being able to make a logical attack on *any* problem, numerical or otherwise, which can be solved by systematic reasoning. Thus numerical problems are important to encourage the development of orderly mental processes in a step-wise fashion of logical reasoning. The mental discipline of exact thinking is an important contribution of natural sciences to cultural education, and our method of teaching problems s h o u l d be chosen to give the greatest encouragement to original thought.

Let us consider possible approaches to the problem of converting a gas volume to new conditions of temperature and pressure. We may learn a formula, $P_1V_1/T_1 = P_2V_2/T_2$ by means of which any of the six quantities involved may be calculated if the other five are known. This general method is widely used in advanced chemistry and physics, but for general chemistry it suffers from the disadvantage that once the derivation is mastered, no further thought is required in its application. Unfortunately, many beginning students never even learn the derivation, but simply memorize a formula. Clearly such an approach does not encourage logical reasoning.

WE MAY learn that the volume of a gas is directly proportional to the absolute temperature and inversely proportional to the pressure. Then the gas volume could be obtained by the use of two proportions, correcting for temperature and pressure changes separately. However, this method would be inconvenient because of the two steps involved are difficult to teach, because a *direct* proportion would be involved in the temperature correction and an *inverse* proportion in the pressure correction. These difficulties discourage most teachers from using the proportion method for gas laws.

Another approach is possible by multiplying the original volume by suitable correction factors to take into account the changes of pressure and temperature. To be sure that the correction factor is not inverted, it is necessary to reason the direction of volume change occurring during the changes of temperature and pressure. The majority of chemistry teachers have found by experience that this method not only works best in solving the problems, but also encourages logical reasoning.

For the past three years at the University of Illinois, we have taught freshmen to work all problems involving chemical calculations by a similar method. Instead of "setting up a proportion", a factor or series of factors is used. Our objection to the proportion method is not that the students cannot be taught to obtain the correct answer. On the contrary, it may be well that (at least at the beginning) the student has more difficulty mastering the factor method. But the object we have undertaken to attain is not proficiency in obtaining the correct answer *per se*, but rather that of requiring careful thought every time a problem is solved.

CONSIDER the calculation of the weight of hydrogen produced by the reaction of 10 grams of zinc with acid. In using the proportion method, we write

$$\underset{65\text{ g.}}{\overset{10\text{ g.}}{Zn}} + 2H^+ \rightarrow Zn^{++} + \underset{2\text{ g.}}{\overset{X\text{ g.}}{H_2}}$$

and solve the proportion $\frac{10}{65} = \frac{X}{2}$, or its equivalent. After having solved such a prob-

lem a few times, the student quickly see that all we need to do to get the proportion written correctly is to erase the chemical equation and insert dividing lines and an equality sign. For that matter, why even the write the proportion as such when we can solve it by "cross-multiplying" $10 \cdot 2 = 65X$? The process of solution soon is reduced to a mechanical sequence requiring no thought.

Using the factor method, one might reason as follows: Since 65 g. of zinc is known to produce 2 grams of hydrogen, one gram will displace just 2/65 g. Then 10 grams will displace ten times as much, or $10 \cdot 2/65$ g.

BUT HOW does the student know that 65 g of zinc and 2 g. of hydrogen are involved in the balanced equation? These quantities might be obtained by some semi-automatic process also unless careful thought is encouraged. To do this we drill the students in numerous types of quantitative interpretation of equations, expanding the structure as new concepts are introduced. Thus, consider the equation

$$C + O_2 \rightarrow CO_2$$

At first we interpret it to mean that two atoms of carbon and one molecule (containing two atoms) of oxygen react to produce one molecule of carbon monoxide. Next the concept of gram-molecular weight (or gram-molecule or mole) is introduced by emphasizing from the beginning the significance of Avogadro's number. Thus if one atom of carbon reacts with one molecule of oxygen, then one billion atoms react with one billion molecules, etc. Now take 6×10^{23} atoms of carbon, which weigh 12 g., and call this a gram-atom because we chose the number of atoms so that the weight is numerically the atomic weight. This many carbon atoms react with an equal number of oxygen molecules, but since each oxygen molecule weighs 32/12 as much as a carbon atom, the weight of 6×10^{23} oxygen molecules will be 32 g. Obviously, this approach to the gram-molecule is not the historical one, but it helps to teach the rather difficult concept that the gram-molecule of every substance has an equal number of molecules, by making that number definite.

Then our equation can be read:

"one gram-atom of carbon reacts with one gram-molecule of oxygen" . . . etc.

"12 grams of carbon react with 32 grams of oxygen" . . . etc.

"12 grams of carbon react with 6×10^{23} molecules of oxygen" . . . etc., and so forth.

After the gram-molecular volume concept is introduced, we extend the meaning:

"one gram-atom of carbon reacts with one gram-molecular volume of oxygen"

and "one gram-atom of carbon reacts with 22.4 liters (S. C.) of oxygen". By Gay-Lussac's Law, we, of course, can also relate the volumes of oxygen and carbon dioxide,

"one liter of oxygen yields one liter of carbon dioxide"

"one cubic foot of oxygen yields one cubic foot of carbon dioxide" and so forth.

BY CHOOSING problems requiring a wide variety of interpretation of equations it is possible to discourage very strongly the use of mechanical rules, and by proper testing it is easy to tell whether the student actually is following a logical system. Thus we can ask questions which test small units of achievement separately. For example, we might ask, "How many molecules of oxygen are obtained by decomposing 10 molecules of $KC1O_3$?", or "How many grams of oxygen are obtained from 6 moles of $KC1O_3$?" etc.

There is an advantage, especially in more advanced types of problems, in using the gram-molecule or gram-atom as the fundamental unit. Thus the first problem above would be reasoned as follows: One atom of zinc displaces one molecule of hydrogen; therefore one gram-atom of zinc displaces one gram-molecule of hydrogen. Ten grams of zinc represents just 10/65 of a gram-atom. Hence we have 10/65 of a mole of hydrogen, or $10/65 \times 2$ grams.

This procedure is readily extended to many types of problems, since the number of moles can be converted readily into volume of gas, number of molecules, freezing point depression, or boiling point elevation by use of the proper factors. It is readily adaptable to the solution of problems based on Faraday's Law. In these problems it is well to stress the concept that a faraday of electricity involves the passage of 6×10^{23} electrons. Thus the equation:

$Cu^{++} + 2e^- \rightarrow Cu$ can be read

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Some Tree Walk Games

By LYNN ZWICKEY

East Commerce High School — Detroit, Mich.

Editor's Note: These notes on tree walks represent procedures which Mr. Zwickey found very useful in his teaching of biology. Others may want to try these "trade tricks".

MY STUDENTS beg for tree walks as soon as the weather makes them feasible. The popularity of such walks seems to be much increased by reduction in the amount of lecturing and increase in the use of games.

The game notion is linked with "winning" or with reward. These procedures have been rewardingly successful:

I. Toothpick quiz: The teacher has a pocketful of toothpicks. They are to serve as awards. The class stops under a tree.

Teacher: What is it? Hands!

John: Norway maple!

Teacher: Good. Here's your toothpick.

Under the next tree:

Teacher: This one?

Mary: Silver maple!

Teacher: A toothpick for you.

II. Toothpick quiz variation:

Teacher: What kind of tree is this?

Mable: Ash.

Teacher: No. Hands? This is a two-toothpick question because Mable missed.

Jack: Hickory!

Teacher: Three-toothpick question!

Evelyn: Box-elder!

Teacher: Good! Here they are.

III. Toothpick quiz — variation:

Teacher: What is this tree?

Harry: Box-elder.

Teacher: How many agree? Hands? (5 hands) How many disagree? (7 hands) Again—how many agree? (5 hands) Keep them up—you earn a toothpick each?

Note: The award can be proportional to the number right. The harder the question becomes and the fewer who agree, the more toothpicks. Don't forget to keep them guessing by awarding toothpicks to correct *dis*agree-*ers*.

IV. Toothpick game. Fallen leaves in October. Find a place where leaves are fallen and blown in great abundance and variety, *e.g.*, the windward side of a tennis court.

Teacher: (Stooping quickly and picking up a leaf which he raises high in the air for everybody to see). A toothpick for the first one like this!

(Everybody scurries about for a few seconds. Jim and Bob find matching leaves almost at the same instant and hold them up.)

Teacher: Right. A toothpick for each.

V. Fallen leaves — variation. Same type of locality.

Teacher: A toothpick for the first linden. (Everybody scurries, etc.)

Teacher: Here's a harder one. Three toothpicks for the first burr oak. Etc.

On the return to the classroom, students write names on slips of paper, push their toothpicks through the slips, and turn them in. Credit is given. The procedure thus becomes an "extra-credit" test without the stigma of the word "test."

THE VARIETY of approaches is limited only by the imagination of the teacher.

In prewar days, when Scotch tape was still extant, it was easy to arrange an assortment of all the common leaves on an unused blackboard. A pointer game could be used to fill loose-end (clock-watching) minutes at the end of a period. Here again the reward is important.

Teacher: Everybody tally his right answers on a slip of paper.

Teacher: (At end of period) Turn in your slip!

Make it go fast. When their answers come too quickly and too easily, discontinue for a week or so.

OUR FRONTISPIECE

The Airacomet shown on the cover is the first American jet-propelled plane. Its performance detail has not yet been announced, but it is known to have a high speed and a high ceiling. This streamlined new fighter has no propellors.

Tested Group Experiments in General Science

EDGAR W. BAILEY

Shorewood High School — Shorewood, Wisconsin

BEGINNING teachers of ninth year science usually find that group experiments offer so many problems that they turn to the demonstration method, often abandoning the group experiment completely. The chief problems encountered are (1) lack of sufficient equipment, (2) lack of proper equipment, (3) lack of time to prepare the equipment, (4) excessive breakage of expensive apparatus, (5) immaturity of the students, which makes it difficult to obtain real scientific results.

While these objections, and many more, too, are valid, it is desirable for the beginning science student to have some first-hand experience in handling laboratory tools. High school freshmen are not satisfied by watching some one else perform an experiment; they want to try it also. Over a period of years I have found that certain experiments lend themselves to group work. They require a minimum of apparatus, mostly inexpensive; they are not dangerous; and they are flexible, in that the experiment can be set up for a bright group or a slow group.

EACH experiment can profitably take a full class period or more. Each one can be set up in a minimum of time. Also, each can be followed by demonstrations which enhance the value of the experiment.

List of Tested Group Experiments in General Science

- * 1. Learning to weigh and measure.
- 2. Finding the oxygen content of air.
- 3. Making and testing carbon dioxide.
- * 4. Testing water for hardness.
- 5. Purifying water by settling and filtering.
- 6. Archimedes principle.
- * 7. Testing acids and bases.
- * 8. Smelting a metal from its ore.
- 9. Surface tension and capillarity.
- 10. The lever.
- 11. The pulley.
- *12. The law of reflection.
- *13. Images in a plane mirror.
- 14. Image by a convex lens.
- *15. Magnetic lines of force.
- 16. The electro-magnet.
- 17. Electro-plating.
- 18. Making a small electric motor.
- *19. Dissection of a flower.
- *20. Dissection of a seed.
- *21. Study of an insect.
- *22. Testing of cloth.
- *23. Removing stains from clothing.
- *24. Testing food for starch and sugar.
- *25. Identifying rocks and minerals.

THE ABOVE list was compiled entirely out of my own experience. Not every teacher of general science would agree with it. However, I believe any teacher would be safe in using any one of the experiments as a group experiment.

The starred experiments are those in which it is possoble to use individual equipment so that each person works separately. Such experiments are always more interesting to the student. It is possible to arrange the entire list for individual work without too much expense.

When accompanied by appropriate demonstrations, this list will comprise from one-third to one-half of the experimental work of the average general science class. This, however, must not be taken as a guide, since many modern teachers will use more than 100 experiments and demonstrations in a year's course.

The N. S. T. A. and several of its Affiliated Groups, The Federation of Science Teachers Association of New York City, The New Jersey Science Teachers Association, The New York State Science Teachers Association, and the Philadelphia Science Teachers Association collaborated in the Annual Conference of the Middle States Science Teachers Association held at the Hotel New Yorker, November 24 and 25.

Dr. Philip G. Johnson, president of the N. S. T. A., spoke recently before the Philadelphia Science Teachers Association.

Science for Society

EDITED BY JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Background of Our Science Legislation

JOSEPH SINGERMAN

Commerce High School New York, New York

"Man is left . . . with a crisis in decision. The main test before him involves his *will* to change rather than his *ability* to change." Norman Cousins in *Modern Man Is Obsolete*.

Public Misinformed

PUBLIC awareness of the role of science is becoming increasingly apparent, stimulated no doubt by the advent of the atomic bomb. Much discussion is taking place through various organs of the press, and legislative measures are being whipped into shape.

But a condition of complete information and a state of confusion and indecision are rampant. Some months after the Nagasaki and Hiroshima premiere, it was still possible to witness a "town hall" discussion in a large metropolitan high school in which the practically unanimous contentions of scientists in America were ignored. And vigorous action on the part of teachers of science is still to get under way.

This confusion is a product of a lack of complete information as well as the dissemination of misinformation, both resulting from the effects of a powerful military bid for power and the play of international politics. Pressure of military interests resulted in the introduction of the original May-Johnson atomic energy bill and probably came very near to bringing about its passage with undignified and precipitate haste. It was generally charged that scientists, including those who not only had intimate knowledge of the development of the atomic bomb but who also were competent to inform the public of its possible effects and of the potentialities in man's utilization of atomic energy in general, felt restrained from voicing public expression of opinion for fear it would result in serious measures of reprisal under security regulations. It is disturbing to note that, even at the present writing, British atomic scientists have not been heard from, though they are as much disturbed as were their colleagues over here.

Among items of misinformation, has been the dangerous, though ridiculous contention that our atomic developments can be kept secret. There have also been statements regarding defensive weapons, actual and potential, against possible attack by atomic bombs. A commonly accepted belief that every new offensive weapon in the past was followed by the development of an adequate defensive weapon, and that this will surely follow in the future, is doubly fallacious. Against air attack, they would tell us, we have developed radar controlled guns and proximity fuse shells. But, to cite this as an example, we all know that most planes do manage to get through. We have but a partial defense, as witness widespread destruction of property and life. Moreover, the atomic bomb cannot be casually pigeonholed as just another weapon. It would require few such bombs to completely destroy our largest cities. Dr. J. R. Oppenheimer, former Director of the Los Alamos Atomic Bomb Project, says that it might be possible to kill 40 million persons in one raid on the United States.

AMERICA is playing its part in international power politics. Of the big nations, we alone emerged from this war practically unscathed. More, we find ourselves with a greatly augmented productive capacity while our allies are desperately in need of machinery and manufactured products. Liberated

nations are in dire need of relief. Our financial and relief facilities are being offered only on condition that the prospective recipients modify their democratic aspirations to satisfy the wishes of our own financial interests. And diplomatic recognition by us of fascistically oriented nations, and military assistance to reaction in one nation are not viewed with complacency by other nations of the world. Meanwhile, some of our generals, totally ignorant of the lesson of modern history, arrogantly talk of war with the Soviet Union. To complete this picture, consider these facts in the light of our present exclusive possession of the atomic bomb together with expressed determination to keep its manufacture secret, and you have a picture which other nations may view with considerable uneasiness.

Shortsighted Policy

NOTWITHSTANDING our protestation of altruism, the wisdom of this course of action is being seriously questioned by some of America's best minds, branding it as either immoral or shortsighted, or both. Those who would fence in our nuclear scientists with secrecy regulations are unaware of the fact that science has blossomed, in the first instance, due largely to its freedom of discussion and to its international character. Should these advocates have their way, American science would be stifled and scientists would be driven from the field of nuclear physics. They would weaken us militarily and lead to an international armament race that would likely end in an atomic war. In a plea that we do not shut off our "scientific capital," Dr. J. C. Stearns, personnel director in the Chicago project, pointed out that of the five scientists first to recognize the importance of the atomic discoveries, four are Hungarian and one Italian.

In reply to advocates of secrecy in atomic research, the Metropolitan Section of the American Physical Society stated, "Advantages which may accrue from regimenting science for military secrecy will be more than offset in the long run by the disadvantage caused by hampered communications among scientists, the difficulty of training young scientists and the general discouragement of scientific initiative." Obviously in response to Winston Churchill's complaint about the Soviet Union's alleged withholding of new military secrets from her allies, J. B. S. Haldane, Fellow of the Royal Society, stated, "Our own country's part in the matter is unfortunate and dishonorable. In his broadcast speech of June 22, 1941, when Hitler invaded the Soviet Union, Mr. Churchill promised to put British technical devices connected with the war at the Soviet Union's disposal."

ANOTHER aspect of shortsightedness lies in an illusion of superiority in temporarily exclusive possession of the atomic weapon. The ability of other nations to produce it in a very short time is generally conceded. The most powerful and wealthy nation would then be completely vulnerable to complete destruction in one unannounced attack from a small power. Of course, provided the identity of the aggressor be known, the victim of this attack may, in its dying gasps, be able to reciprocate with an equally deadly counterattack. Civilization might well destroy itself.

Scientists Speak Up

There has developed a basis for optimism. America is hearing from its scientists, through their organizations, through Congressional hearings. Further hearings were held and will be held pending legislation, and pending bills are being modified. The significance of this should not be overlooked. These are not ivory tower scientists whose voices are being heard. These are men and women who are keenly aware of the relation of science to world conditions. They demanded to be heard. They are being heard. And they are rendering a service to America and to world democracy.

WE SHALL need to set up a means for international control of atomic energy—not a paper of lofty expressions, but an agency to use force, if necessary, to safeguard civilization from destruction. In this, scientists will have to serve a vital function. There will be an extension of the international character of science, and a stimulation of collaboration. In such an atmosphere, science will thrive. As Dr. Oppenheimer said, in response to a question by Senator Fulbright as to whether scientists would cooperate in a world-wide system of control and inspection of atomic

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Integrating Science and Social Studies

A Conservation Unit in Elementary Science

HELEN M. EGAN

Miles Standish School — Cleveland, Ohio

THE HISTORY of the pioneer life of the local community forms an integral part of the social studies course of study in most school systems. Children in learning to understand and interpret the world in which they live, need to know that the habits, customs and ways of living in their own particular locality were "not ever thus." The social studies course of study in Cleveland suggests that this unit be developed with the eight year old child. Needless to say, he finds it most interesting. How he enjoys learning about Moses Cleaveland and his band of surveyors who travelled from Connecticut to the forest-covered "Western Reserve" to establish the beginnings of alittle town! The Carter, Clark and other families, who shortly afterward left Vermont and other eastern states to make their homes in Cleveland, are extremely interesting to the third year child. Their problems of transportation, shelter, food, and clothing are intensely exciting. How he thrills to the ideas of covered wagons, flatboats, hunting and fishing for food, clearing the land for crops, log cabins, homespun and home-made clothing, and even dealings with Indians! What fun for him to participate in such activities as making butter, dipping candles, sawing puncheon boards, making miniature puncheon furniture, constructing log cabins, building miniature flatboats and rafts, conducting old-fashioned spelling bees, singing pioneer songs, playing pioneer games, and visiting the local historical museum!

AT THE suggestion of Miss Anna E. Burgess, supervisor of elementary science in the Cleveland Public Schools, we have used this unit as a beginning and on two occasions — once in autumn and once in spring — rather successfully worked out a unit on the conservation of our natural resources.

Introducing the book, ***Would You Like To Have Lived Then?*** written by Miss Mary Melrose and Dr. Paul E. Kambly and published by the National Wildlife Federation, Inc., we presented to the child the story of a typical pioneer family, the Robinsons, who journeyed not only to the forested regions of Ohio but also to the flat lands of Illinois with its tall grass, and then to the great plains of western Kansas. Everywhere they went, they and the other early settlers found the land rich in natural resources. So they used these treasures very freely, even wasted them. In their time, however, there were so many trees, so many buffaloes, so many fur-bearing animals, so many passenger pigeons, they thought the supply would last forever. These things would have lasted a long, long time for a few pioneers. But more and more people settled in every part of the United States. Then there were many people cutting down the trees, killing the animals, and plowing the land. At particular instances in this story, Grandpa Dave, one of the descendants of the early Robinson family, makes some very emphatic statements about the pioneers, first of which is *They Cut Down Too Many Trees.* This statement led very naturally into a discussion of the importance of trees. Several trips about the neighborhood and to the park were arranged so that the class might observe at close range

- birds' nests in trees
- squirrels' holes and nests in trees
- fallen leaves
- places on hillsides where no trees grow
- shade made by trees
- part played by trees in beautifying the landscape

HAVING an exhibit of foods that come from trees, and collecting pictures illustrating ways in which we use trees were other activities carried on to help explain Grandpa Dave's statement. These facts were finally brought out

- Trees are the natural homes of many birds.
- Trees are the homes of many animals.
- The leaves of trees help to make good soil.

The roots of trees help to prevent soil from being washed away.

Trees furnish shade.

The beauty of trees affords us much enjoyment.

Today as in pioneer days, trees provide us with many foods, such as apples, peaches, cherries, and nuts.

Today as well as in pioneer times, trees supply us with homes, furniture, fuel, boats, wagons, rayon clothing, pencils and even paper.

At another place in the above mentioned booklet, Grandpa Dave seriously declares, "*They Killed Too Many Animals.*" Consideration of the reasons for this statement brought the children to a realization of the following:

Some animals plant seeds.

Animals provide us with clothing today as they did in pioneer times.

Animals provide us with food today as they did in pioneer times.

Still later in the story of the Robinson family, Grandpa Dave solemnly states, "*They Killed Too Many Birds.*" By recalling what they had observed and also by reading, the children arrived at these basic understandings:

Birds eat many harmful insects.

Birds plant seeds.

Birds destroy many weed seeds.

AS THE boys and girls continued to read *Would You Like To Have Lived Then?*, they came upon the next emphatic statement made by Grandpa Dave, *They Plowed Too Much Land.* The harm that is caused by plowing of too much land is explained here. To clarify this explanation, a trip about the neighborhood was taken to see how the soil had been washed away from places, particularly hillsides, where there was no grass. We also went into the schoolyard one day after a long dry period. Here we saw and felt the soil that the wind had blown into the air. These trips in addition to much discussion helped to develop the following concepts:

The roots of grass hold the soil in place.

These roots take in the rain.

When the grasslands are plowed, the rain carries the good top-soil away and washes it down the river.

When the wind blows, it may carry away the dry soil.

The conservation of wildflowers also is discussed in the pamphlet mentioned above. By means of pictures (we were unable to take the class to see the flowers themselves) the children learned to identify a few common wildflowers. The fact that, if each person picked only a few, the wildflowers of our country would soon disappear, was then considered. Finally the understanding that wildflowers in their natural habitat provide beauty and enjoyment for all today as well as in pioneer days was established.

AT THIS time, a spirit of tolerance toward those who have preceded us in point of time pervaded the discussions through consideration of the fact that, even though the pioneers did waste much of our natural resources, they were blameless. Since the supply was so great and the number of early settlers so few, the need for conservation was unforeseen.

Now, the question was raised, "What can we, the boys and girls of Miles Standish School, do to restore these wasted treasures? What can we do about the trees, the birds, the fur-bearing animals and the soil?"

We decided that the only way to compensate for the cutting down of the trees was to plant other trees. This we did, one in the schoolyard and several in the children's own yards. The teacher supplied the seedlings. The protection of the trees now growing, some children realized, was equally important.

Examining the trees in the schoolyard to locate injuries, and covering these with paint was another activity carried on. Finally, the following rules, which the teacher placed on a chart, were composed:

We should make up for the waste of trees by
planting trees
preventing injuries to trees
repairing injuries

NEXT came the question, "What can we do to protect the birds?" The children recalled that some birds, such as the passenger pigeon, have been destroyed and can in no

Continued on Page 39

Science Clubs at Work

dited by DR. ANNA A. SCHNIEB

State Teachers College Richmond, Kentucky

• A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Schnieb.

A Junior High School Project Exhibit

RUSSELL MEINHOLD and R. K. CARLETON*

PROBABLY no single effort has stirred up as much interest in secondary school science as has the Annual Science Talent Search sponsored by the Westinghouse Electric and Manufacturing Company. To the writers, it appears that the stimulus of this contest is one of the most valuable contributions which the field has had since the Edison Scholarships. However, it is at once apparent that this contest goes beyond the Edison Scholarship contests, for it seeks out and motivates research on the high school level. With this splendid opportunity, it behooves all alert science teachers to use this motivation for obtaining greater interest and better project work from their students.

Dr. Carleton congratulates Camilla Boyd on most original exhibit.

Observation and experience has shown that very few students are prepared either in interest or ability to initiate and carry through such a project. It seems obvious that this is the reason for the small number of entrants from most localities, whereas the New York city area always has many entries and a large share of successful candidates. Since science fairs have been common in the metropolitan area, it is evident that these have been a major contributing factor. Sufficient interest cannot be aroused during three years of high school for successful participation in the Westinghouse Contest.

WITH A recognition of this fact, we at Rogers High School in Newport, Rhode Island hit upon the idea of developing the project concept in the grades of the junior high school level. A logical sequence of this was to hold a science fair so that every youngster who wished might have an opportunity to show the results of his efforts. Naturally, by holding a public exhibit, the cut and dried project method employed so frequently by science teachers was eliminated. It so happens that a nmber of surrounding towns send pupils to Rogers High School. The schools

*Mr. Russell Meinhold is Head of the Science department, Rogers High School, Newport, Rhode Island.
Dr. R. K. Carleton is Director of the Science Talent Search for the State of Rhode Island.

Above: The prize winners. Cammila Boyd, Irving Monroe, Colin Cambell, Richard Barbosa, James Michael, and William Hetherington.

associated in the project exhibit were the Thomas Clarke School of Jamestown, the schools of Tiverton, the Joel Peckham School of Middletown, the Henry Anthony School of Portsmouth, and the John Clarke School and the Mumford School of Newport. All pupils in the 7th and 8th grades were invited to enter projects in the fair.

The rules laid down were relatively simple. The most important was that the project should be the result of the pupil's own effort. It must possess originality, and preferably, be constructed with materials found around the home or in the local junk yards and dumps. Suggestions as to the type of project were submitted to teachers. Nature collections of various types were suggested, as well as the usual projects utilizing heat, elecrticity and magnetism, or chemical reactions.

THE DATE of the fair was announced three months prior to its occurrence, in order to permit sufficient time for teachers and pupils to complete their work. Frequent visits were made to the various schools to discuss projects with pupils and teachers, to offer suggestions and give encouragement. The contest was sponsored by the Newport Engineering Society which generously offered the

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Below: Mr. Kenneth Mairs of Newport Engineering Society congratulating Richard Barboza, winner of first prize.

Science the New Frontier

JACOB W. SHAPIRO

Central High School Columbia, Tennessee

SELDOM has such news rocked the scientific world in the past decades as radar, jet propulsion, and now atomic bombs. Seldom have the implications of events been greater to our nation's youth—and our nation's schools.

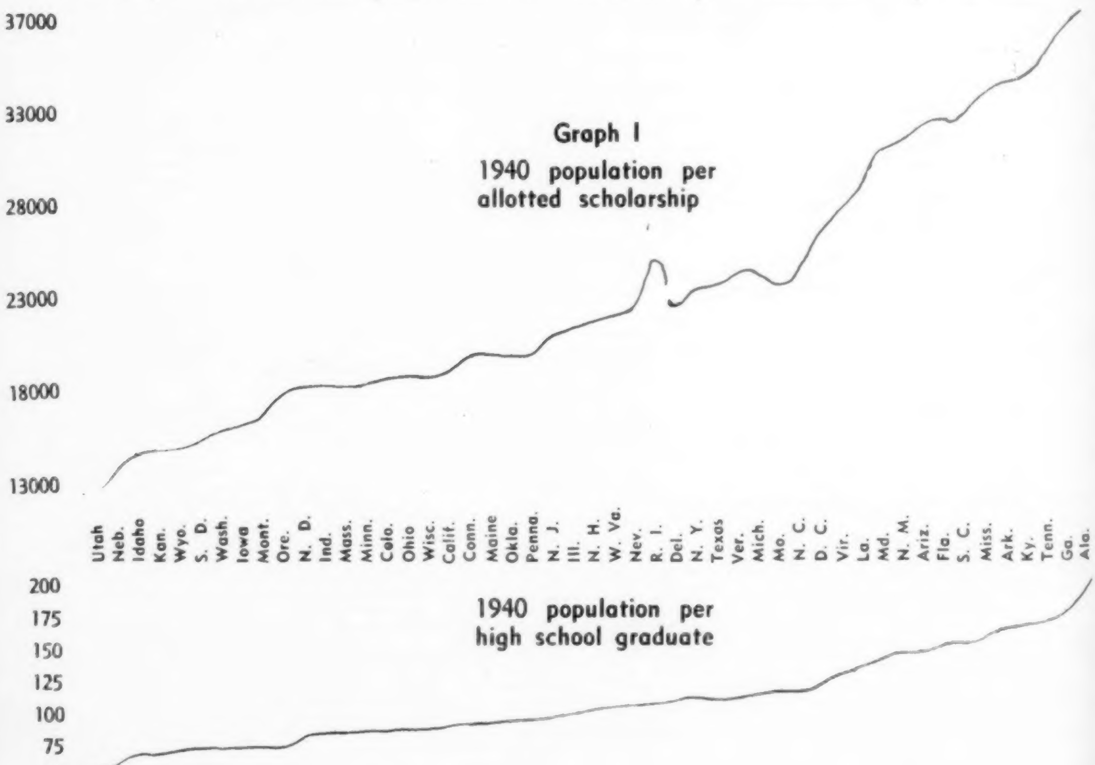
Late in 1944 President Roosevelt addressed a request to Dr. Vannevar Bush, Director of the Office of Scientific Development and Research, for recommendations on the following points:

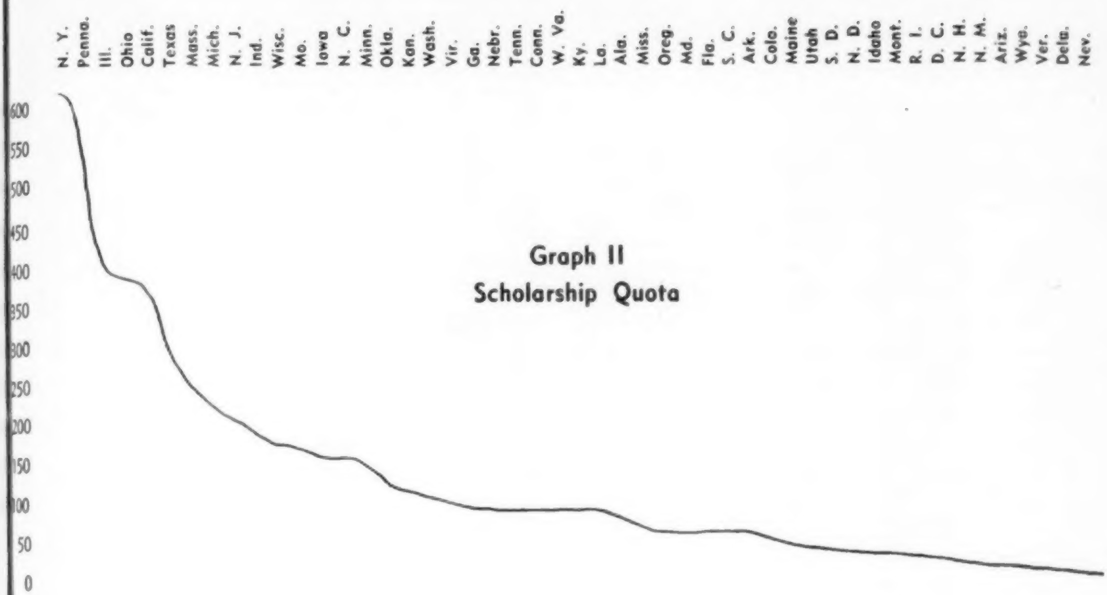
1. How soon can the world be informed of our wartime discoveries as to scientific knowledge?
2. What can be done to further medical research?
3. What is the government's role in public and private research?
4. What can be done to develop the scientific talent of our youth?

Educators of youth on the high school level are chiefly concerned with point four. If we examine the figures given in the report, Science The New Frontier, rendered to President Truman we find that states vary greatly in their ability to retain the student in school as far as high school graduation.

Table I lists (A) the 1940 population, (B) high school graduates, 1939-1940, (C) 1940 population per high school graduate, (D) scholarship quota, and (E) 1940 population per allotted scholarship student. The figures in column C are rounded to the nearest whole number, and those in column E to the nearest hundred.

A careful study of table one will show that some of our poorer states as measured in terms of population, wealth, bank clearings, etc., are doing a better job of retaining the student in school. We must not fall into the pitfall of saying that states of high bank clearings, population, and wealth are able to do better by the children. Graph one demon-





Graph II
Scholarship Quota

strates the ability of each state to retain students as computed from the number of people in each state per high school graduate and per allotted scholarship. Graph two presents evidence that we would expect as to the number of scholarships allotted per state.

Mr. Magnuson and Mr. Mills, members of Congress, have introduced like bills into the Senate and House respectively to establish a National Research Foundation which will be created to meet the urgent needs of the days ahead. The House bill is H. R. 3852. 79th Congress, 1st Session. Every teacher should write for a copy.

The program as suggested and as concerns our schools deals with the discovery and encouragement of scientific talent in our youth. The plan must be designed to attract scientific talent in proportion to the other needs of the nation for high abilities.

The Foundation would make available each year 6,000 undergraduate scholarships. This amounts to one scholarship for each 203 graduates for the school year 1939-1940. Further it provides for 300 graduate fellowships.

The scholars are to be chosen by State Selection Committees and the fellows by a national committee. The scale of support will be that provided by the GI Bill of Rights for Veterans, namely, up to $500 annually for tuition and fees plus $50 monthly for personal support if single, and $75 monthly if married. The scale of support for fellows will differ slightly in that they are to receive $100 monthly for personal support.

The screening will involve:

1. Score on test of scientific promise.
2. School record, especially rank-in-class.
3. Application with inventory of activities and interests.
4. Recommendations of principals and teachers.

It is further stated in the proposed bill that the scholarship and fellowship students would furnish a reserve of trained scientists for any national emergency that might arise. It must be emphasized that this is a very worthwhile investment in our youth when one considers the safety and prosperity of our nation.

Table II demonstrates the ability of the various states to keep their pupils in school until high school graduation. The state with the lowest number of people per high school graduate is ranked first (column A) etc. Here we see some of our states with the greatest expenditure per student in the middle third of the table. Likewise our states with lowest expenditures per student rank low in the bottom third of the table. Column B gives the rank of the states by quota allotted contrasted against column A.

Continued on next page

It behooves each educator to examine his community, and his school to determine where he can improve his work.

Table I

State	A	B	C	D	E
Ala.	2,832,961	16,222	175	80	35,400
Ariz.	499,621	3,498	143	17	29,400
Ark.	1,949,387	12,226	159	60	32,500
Calif.	6,907,387	72,301	96	356	19,400
Colo.	1,123,296	11,900	94	59	19,000
Conn.	1,709,242	17,614	97	87	20,100
Del.	266,505	2,353	113	12	22,200
Fla.	1,897,414	12,666	150	62	29,900
Ga.	3,123,723	18,302	171	90	34,700
Idaho	524,873	6,815	77	34	15,400
Ill.	7,897,241	75,508	105	372	21,200
Ind.	3,427,796	37,470	92	184	18,600
Iowa	2,538,268	30,671	83	151	16,800
Kan.	1,801,028	23,326	77	115	15,700
Ky.	2,845,267	17,675	161	87	32,700
La.	2,363,880	17,405	136	86	27,500
Maine	847,226	8,485	100	42	20,200
Md.	1,821,244	13,016	140	61	28,500
Mass.	4,316,721	46,830	92	231	18,700
Mich.	5,256,106	44,522	118	219	24,000
Minn.	2,792,300	30,337	92	149	18,700
Miss.	2,183,796	13,979	157	69	31,800
Mo.	3,784,664	33,343	118	164	23,100
Mont.	559,456	6,617	84	33	16,900
Nebr.	1,315,834	17,970	73	88	14,900
Nev.	110,427	1,005	110	5	22,100
N. H.	491,524	4,670	107	23	21,600
N. J.	4,160,165	39,973	104	197	21,100
N. M.	531,818	3,745	142	18	29,600
N. Y.	13,479,142	117,901	114	580	23,100
N. C.	3,571,623	30,372	118	150	23,800
N. D.	641,935	7,182	89	35	18,300
Ohio	6,907,612	73,616	94	362	19,100
Okla.	2,336,434	23,467	100	116	20,100
Ore.	1,089,684	13,002	84	64	17,100
Penna.	9,900,180	99,351	100	489	20,100
R. I.	713,346	5,978	112	29	24,600
S. C.	1,899,804	12,687	150	62	30,700
S. D.	642,961	8,059	80	40	16,000
Tenn.	2,915,841	17,857	163	88	33,100
Texas	6,414,824	56,348	114	277	23,200
Utah	550,310	8,212	67	40	13,700
Ver.	329,231	3,130	115	15	23,900
Vir.	2,677,773	20,263	132	100	26,800
Wash.	1,736,191	21,170	82	104	16,700
W. Va.	1,901,974	17,571	108	87	21,900
Wisc.	3,137,587	33,464	94	165	19,000
Wyo.	250,742	3,213	78	16	15,700
D of C.	663,091	5,278	126	26	25,600

Table II

State	A	B		A	B
Utah	1	36.5	Mass.	13	7
Nebr.	2	21	Minn.	13	15
Idaho	3.5	39	Colo.	16	34
Kan.	3.5	17	Ohio	16	4
Wyo.	5	46	Wisc.	16	11
S. D.	6	36.5	Calif.	18	5
Wash.	7	18	Conn.	19	24
Iowa	8	13	Maine	21	35
Mont.	9.5	40	Okla.	21	16
Ore.	9.5	29.5	Penna.	21	2
N. D.	11	38	N. J.	23	9
Ind.	13	10	Ill.	24	3

	A	B		A	B
N. H.	25	43	Vir.	37	19
State	A	B	La.	38	26
W. Va.	26	24	Md.	39	29.5
Nev.	27	49	N. M.	40	44
R. I.	28	41	Ariz.	41	45
Del.	29	48	Fla.	42.5	31.5
N. Y.	30.5	1	S. C.	42.5	31.5
Texas	30.5	6	Miss.	44	28
Ver.	32	47	Ark.	45	33
Mich.	34	8	Ky.	46	24
Mo.	34	12	Tenn.	47	21.5
N. C.	34	14	Ga.	48	20
D. of C.	36	42	Ala.	49	27

JUDGING SCIENCE TEACHING

Continued from Page 19

neighborhood because of his position as a science teacher? Does he believe that community service, scouting, camping, and subsistence farming have a place, at least equally important to universal military conscription?

12. *Does the science teacher provide opportunity for free and democratic discussion?* Many science teachers limit themselves to the lecutre method. Issues which stem out of science experience and discoveries call for discussion. Science teachers should welcome the science problems which confront youth. The beach heads of science should be dealt with in the most honest and forthright manner. The kind of science teachers we are to have in the next decade not only calls for "speaking up" but action.

WRITE FOR IT

Write to SPENCER LENS COMPANY for—

Microscopy in Medicine. A 28 page booklet which describes the microscope and gives instruction for its use in the medical field, including the study of bacteria.

Opaque Projection. A 36 page manual to help the teacher make the greatest and most profitable use of the opaque projector. Lists some sources of free and inexpensive materials suitable for projection.

Wall Charts. Large, showing parts of the microscope. Also one showing the path of light through the lenses and how the image is formed.

Spencer Lens Company, Rochester, New York.

Oil, Product and Pillar of Freedom. 14 page booklet. Standard Oil Company, 30 Rockefeller Plaza, New York 20, New York.

Oil for the World. A 16 page booklet. Standard Oil Company, N. Y. C.

A Scientific Alarm Clock

HERMAN BERLIN

Franklin K. Lane High School — Brooklyn, New York

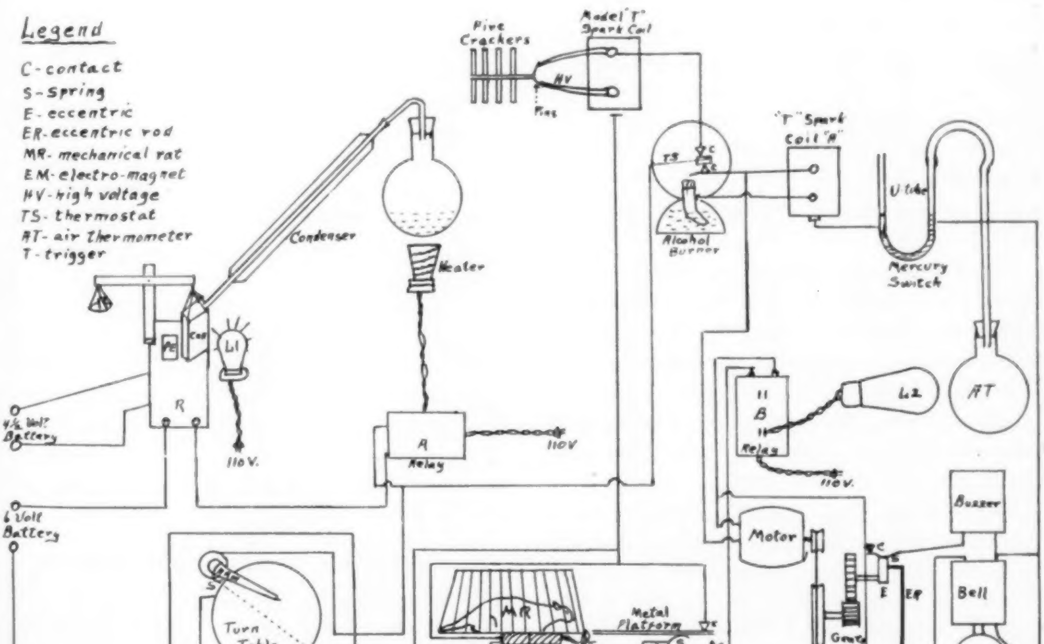
THIS DEVICE was assembled to provide a humorous touch to a dinner meeting of the physical science department at the Franklin K. Lane High School. It was later demonstrated at Cooper Union before the members of the Physics Club of New York City. It never fails to arouse the interest and imagination of science students. For motivation and review it has some value. Basically it is modelled along the lines of the "Rube Goldberg" cartoons, in which a simple action results from a complicated train of events. The operation of the "alarm clock" is as follows:

1. Before retiring the owner pushes the plugs of the two relays and the lamp "L 1" into wall outlets of the house current supply. The heater causes the water in the Florence flask to boil. The steam goes through the condenser, turns back to water and drops into the can on the beam balance. Weights on the pan adjust the amount of water necessary to bring the can down so as to cut off the light from PE, a photo-electric cell. The distance between the flask and the electric heater also can be adjusted to regulate the speed of evaporation.

2. When the light is cut off from the photo-electric cell, the miniature relay, "MR", closes the circuit for the larger relay, "R".

3. The current from the six-volt battery shuts off the electric heater element and releases the stop from the turn-table of the victrola, by means of an electromagnet, EM. A spring, S, attached to the arm, slides on a small metal plate attached to the platform near the turntable. This plate is wired to the electromagnet.

4. The victrola plays a record—"Birds in the Forest" by Grieg. The calls of the birds should arouse the sleeper. If not, the arm, reaching a certain part of the record, closes the circuit of another electromagnet, EM, un-



der the rat cage. The spring under the arm pushes against a stop, stopping the turntable, and closing the circuit of the second EM.

5. The second electromagnet releases the trigger, T, on the door of the rat cage. The rubber rat, pulled by a rubber band, moves on to the metal platform.

6. The weight of the rat brings the platform down against the lower contact, C. This closes circuit through relay B to the motor and for the lamp, L2.

7. The motor rotates an eccentric, E, and moves an eccentric rod, ER, attached to a pin on the side of the eccentric. The bell and the buzzer operate alternately.

8. The heat from the lamp passes towards the blackened bulb of an air thermometer, AT, and is absorbed.

9. The air inside the bulb expands and presses against the mercury in the glass U-tube. When the mercury in the left leg rises so that it touches CW, a contact wire sealed where it passes through the glass, the circuit is closed through spark coil A.

10. The spark from coil A ignites the alcohol burner.

11. When the flame has heated the bimetallic strip, TS, the latter bends upward until it touches the upper contact, C. The circuit for spark coil A, the motor, and L2 are opened, shutting them off. The circuit is closed for spark coil "B".

12. The spark coil "B" sets off the string of fire-crackers.

13. A frying pan containing strips of bacon (if you can get them) and a prepared coffee percolator could be joined by a triple plug which is then pushed into the free side of relay A before the person retires. In this way, breakfast could be ready and waiting. An automatic toaster, attached to the triple plug, could pop up finished toast.

The students who saw this alarm clock in operation suggested many accessories, such as a pail of ice-water tipped by electro-mechanical means over the head of the sleeper.

For science clubs, science fairs, and for motivation this device should serve to lighten the deadly-in-earnest tone of all science meetings.

SCIENCE LEGISLATION

Continued from Page 25

matters, "I'll go you one better. I think there are no technical problems there, only political problems. If the political problems are solved, the scientists will be in green pastures. They'll have a wonderful time helping." As expressed by the Division of Science and Technology of the Independent Citizens Committee of the Arts, Sciences and Professions, ". . . the United States (should) champion the need for international development with the broadest utilization of all resources and the widest freedom of research and interchange of ideas."

All who are interested in Science, are taking a keen interest in various proposals for placing supervision and control of new weapons in the United Nations Organization. Some such plan will succeed because it must succeed. Arguments that we cannot depend on an untried "paper" organization are as specious as were similar arguments opposing the formation of a union of the thirteen states into a stronger and more powerful Union. It is imperative that a world organization be set up at once, not just on paper, but one with teeth. America must take the lead, not only as the greatest nation in the world today, but also because we have developed and used the weapon which can conceivably destroy civilization. Those who would withhold world cooperation from an untried UNO are unwittingly playing into the hands of enemies of cooperation. Every bridge is untried before it is put into use. Democracy was untried before man first put it into operation. But man needed democracy to enable him to climb to higher levels of human dignity just as much as he needs the bridge to reach the opposite river bank. The greater urgency with which an effective UNO is needed today is to the original quest for democracy as the devastating power of the atomic bomb is to the explosive power of a thirty millimeter shell.

Aid to Science Education and Research

PENDING science legislation extends in purpose from purely domestic objectives all the way to international relations. Of those bills aimed to promote science education and research, only the Magnuson-Kilgore proposals

have received serious consideration, and these have been considered jointly. The provision of the Magnuson bill to permit private or institutional monopoly of patents resulting from Federally financed research is vigorously denounced by a majority of scientists. The American Association of Scientific Workers urges that "The Foundation should make these patents and rights available to industrial and business application on the basis of non-exclusive licensing agreements." Another shortcoming of the pending legislation is revealed by the Scientific Workers recommendation "that the proposed Foundation be empowered to aid and support research in government laboratories as well as in those of public and private institutions." The National Science Foundation, which the Senators propose to set up, should be under the direction of a competent civilian administrator. Only thus can its program thrive.

A peculiarly serious weakness in the proposed plan lies in dependence upon unsalaried or "dollar a year" directors. This is a common mistake in this country. Whether it may be explained as a manifestation of our desire to get something for nothing or our unconscious admiration of those who do not have to work for a living, it is an attitude that is shortsighted and unwise. As we learned in physics, that one gets nothing for nothing, so it is in economics. If we want reliable and expert service, we must be ready and willing to pay for it. Directors in the National Science Foundation should be responsible to the public. Only by offering adequate salaries can the government hope to attract and maintain the services of men and women of highest competence. Government service requires and deserves the best.

IT IS VERY likely that the foundation for scientific talent is laid in the high school. The October issue of *The Science Teacher* describes the High School Science Act of 1945, introduced by Senator Thomas of Utah. Hearings on this bill may be opened by the time this writing comes off the press. Scientists and teachers of science should voice vigorous protest against that provision of the bill which accepts the condition prevailing in some of our states in which inferior standards of education are provided for Negroes. This it does by presuming to require "just and equitable apportionment" for these schools. It would be more fitting, as a science measure, to refuse support for any school system which practices discrimination by setting up a double standard.

Need for Revolutionary Decisions

The advent of atomic energy calls upon people of the world to make revolutionary decisions. There are those who, as in the past, would again endanger the nation and lay the formation for a disastrous world conflgration. Among these are seekers of world economic domination and those who fear loss of present domination or monopoly that may result from the universal application of new scientific discoveries. The army sponsored May-Johnson atomic energy bill, even in its modified version, is an expression of the fears of these individuals. Such legislation would discourage scientific progress and promote conditions that might precipitate another war.

There are indications, at the present writing, that our leading scientists will sponsor a measure that would promote and encourage research in atomic energy, not for war but for better living and international harmony. Those polticians who have been most vociferous about scientists lacking in ability to advise on world policy should be reminded that they failed utterly in the past. It is these politicians who have been trying to suppress these scientists by intimidation. Of the two, it seems the latter have the greater confidence in democracy.

Cooperative Achievement Tests. An announcement of cooperative achievement tests now available, including those in the field of science. The Cooperative Test Service, 15 Amsterdam Avenue, New York 23, New York.

Elementary Applied Electricity. L. Raymond Smith, Dickinson High School, Jersey City, N. J. McGraw-Hill Book Company, New York, New York, 1943. Prepared in conformance with official pre-induction training course outline No. PIT 101. 311 pp., 11.5x19 cm. 282 illus. $2.00, list.

CHEMICAL ARITHMETIC

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"one cupric ion and two electrons give one copper atom" or 6×10^{23} cupric ions and $2 \times 6 \times 10^{23}$ electrons give 6×10^{23} copper atoms" or "1 gram-ion of Cu^{++} and 2 faradays of electricity give 2 gram-atoms of Cu" etc. Then it is necessary to point out that experimentally, a faraday turns out to be 96,500 coulombs (ampere-seconds) of electricity. To compute the weight of copper deposited by 8 amperes of current in 6 hours we divide the number of ampere-seconds by 96,500 to get the number of faradays. From the ion-electron equation, two faradays are required to give one gram-atom of copper, which weighs 63.6 g. Thus the weight is

$$\frac{8 \times 6 \times 60 \times 60}{96{,}500} \times \frac{1}{2} \times 63.6 \text{ g.}$$

IT IS EASY to see how fairly involved problems can be solved by using a proper series of factors. For the engineering student and others who like to work numerical problems with the aid of a slide-rule, there is a practical advantage in having a single series of fractions to be multiplied together, rather than a series of proportions to be solved.

For the non-major in chemistry, only the simpler problems would need to be considered, but even the simplest problems give considerable practice in logical reasoning. Often the students, especially those who learned the proportion method earlier, object that this method is hard to learn. However, as they receive more practice and as the problems become more involved, the students see the practical utility of the method and no longer express any desire to return to the proportion method. We feel definitely that the additional effort invested at the beginning is more than repaid by the more thorough training given to the student.

Piloting and Maneuvering of Ships. Lyman M. Kells, Willis F. Kern, and James R. Bland; all of U. S. Naval Academy. McGraw-Hill Book Company. New York, 1943. 181 pp., 15x22.5 cm. Numerous illustrations. $2.00.

INTEGRATING SCIENCE

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way be restored. Birds now living, however, need our help particularly in winter. First the children told what birds they had seen in winter. Then they supplemented their information by reading to find out what other birds are winter residents. Much reading was also necessary to find out what food these birds eat.

In the handcraft classes, several feeding stations were built. One of these was placed on a tree in the schoolyard where we could see it from our window. The boys and girls then formed committees whose responsibility it was to keep the feeding station filled with crumbs, corn, sunflower and pine seeds, peanuts, acorns, and apples. Many children also set up feeding stations in their own yards. At Christmas time we decorated one of the evergreen trees in the schoolyard with strings of popcorn, cranberries, and peanuts. In the handcraft class, one of the children made a very simple suet feeder which we filled and hung on a tree. In the spring, several of the boys made simple bird houses and set them out.

Next came the problem of what to do about the wasted grasslands. We examined the school lawn for bare spots and planted grass seed. Many children reported that they had helped to repair their lawns at home.

In regard to the destruction of wildflowers, our only task was to refrain from picking them, and to encourage others to do the same.

THE STUDY of modern Cleveland which also is required in the social studies course of study worked into this integrated unit very satisfactorily at this time. Here the children became acquainted, to a limited extent of course, with the advantages of its geographical location; the dependence of its people upon others for their food, clothing and shelter; the necessity and advantage of its laws; the part played by the health, police, fire and park departments; and the necessity and use of taxes.

Here too, the problem of conservation entered quite naturally into the situation. The children, by observation and reading, learned that even though modern Cleveland provides a suitable place for approximately a million people to live in, it falls short in that many Clevelanders could but do not participate in the restoration and preservation of the natural resources. Looking to the future, the class foresaw that, only when every citizen understands and does his part in the conservation of its natural resources, will Cleveland become the beautiful city which its title "Forest City" implies.

WHO IS GOING TO IMPROVE?

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7. The first and second vice-presidents shall assume such duties as the guiding committee may specify. The first vice-president shall assume the office of president if a vacancy occurs.

8. The secretary-treasurer or the secretary and the treasurer shall maintain a record of all official business of the association and the treasurer shall pay all bills approved by the guiding committee and ordered by the president. The report of the treasurer shall be audited each year by a committee appointed by the president and approved by the guiding committee. The secretary shall make an annual report to the secretary of the national association.

Article IV. Adoption:

This constitution shall become effective 30 days after its approval by the executive committee of the local organization of science teachers and adoption by a majority of the members in attendance at a regularly announced meeting.

1. This constitution may be amended by a two-thirds majority of the guiding committee followed by a simple majority of the active and associate members in attendance at a regularly announced meeting.

2. Amendments may be proposed by individual members, by officers and by members of the guiding committee.

BY-LAWS

Roberts' Rules of Order shall govern the conduct of all business meetings of the local association.

OUR SCIENCE ACT

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Association, will be willing to do three things:

1. Write to the members of the Senate Committee on Education and Labor. Urge favorable action on S. 181, and hearings, or action, on S. 1316.

2. Write to the two Senators from one's own State. Give the numbers and the purposes of the two Acts clearly. Do not worry too much about the details of the bills, for Congress will work on these when the Acts are actually under consideration.

3. Get other teachers, school board members, and citizens with sound ideas on education to write. Let each letter present arguments in the writer's own way. Personal letters have much weight with members of Con-

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gress, but they must not appear to be mere "form letters."

The members of the Senate Committee on Education and Labor are given in the following list.

Alabama: Lister Hill; *Arkansas*: J. William Fulbright; *Delaware*: James M. Tunnell; *Florida*: Claude Pepper; *Louisiana*: Allen J. Ellender; *Massachusetts*: David I. Walsh; *Minnesota*: Joseph H. Ball; *Missouri*: Forrest C. Donnell; *Montana*: James E. Murray, Chairman; *New Jersey*: H. Alexander Smith; *New Mexico*: Dennis Chavez; *Ohio*: Robert A. Taft; *Oregon*: Wayne Morse; *Pennsylvania*: Joseph F. Guffey; *South Carolina*: Olin D. Johnson; *Utah*: Elbert D. Thomas; *Vermont*: George D. Aiken; *Wisconsin*: Robert M. La-Follette, Jr.

You know, of course, the names of Senators from your own State.

THIS MEANS a considerable effort at letter-writing on your part. But your labor is an investment, which may mean much for education and for science. Will you make this effort? Facing the "green light" gvien by the N. E. A. and the N. S. T. A. will you put forth the extra power?

May we, as teachers, expect the acceleration of a real "go-ahead" unless that power is exerted?

If we fail, as teachers, to exert ourselves when the "green light" appears, do we deserve to go forward into better things?

ATOMIC ENERGY

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isotopes behave alike chemically, they can be separated only by properties which vary because of the difference in their masses.

The space alloted to this article does not permit a detailed discussion of this problem. Suffice it to say that this was one of the big problems that scientists had to solve in the production of the new bomb. The Clinton Engineering Works at Oakridge, Tennessee concentrated on this phase of the bomb. The Hanford Engineering Works, Pasco, Washington devoted its attention to the manufac-

ture of plutonium. Since plutonium is not an isotope of uranium it may be separated from uranium by chemical means: thus eliminating one of the most difficult problems encountered in the quest for nuclear energy. This may become the chief source of nuclear energy.

Note: Anyone interested in learning of the problems and the work that went into the development of the atomic bomb should get the official report "Atomic Energy for Military Purposes", by Henry D. Smyth. This can be obtained from the Supt. of Documents, Washington, D. C. or The Princeton University Press, Princeton, N. J.

PROJECT EXHIBIT

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prizes awarded to the winners. Inasmuch as school law does not permit cash prizes to be awarded to school children in the State of Rhode Island, the prizes consisted of science books selected for boys and girls of the age levels of the competitors. Publicity was no problem. The local newspapers gave the fair considerable attention.

The fair was held on Saturday, March 24th. Projects were on exhibition from 10 a.m. until 1:00 p.m. Over two hundred boys and girls brought in projects. For any teacher who knows and likes children it was a tremendous thrill to see them eagerly setting up their projects with considerable pride. Evident also was the splendid sportsmanship, neighborly regard and interest in the other fellow. The projects were of all conceivable types, including such items as butter making, bird houses, plant transpiration, collection of native sea shells, native woods, history of communication, stills, destructive distillation of coal, astronomy charts, electric indicator weather vane, and even a home-made microscope that worked.

ALONG with the fair, a suitable program of films and speakers was presented. Dr. Michael F. Walsh, Superintendent of the Newport, Rhode Island schools, welcomed the young scientists. They were also addressed by Dr. R. K. Carleton, SCA Director in Rhode Island. As to films, we were able to secure "Scientists for Tomorrow" and "Electronics

at Work" from the Westinghouse Company. Both speakers and films were enjoyed by the youthful audience. We were very fortunate too, in obtaining as judges three men with strong scientific background. These were: Dr. R. K. Carleton of the chemistry staff of Rhode Island State College; Mr. J. Herbert Ward, Head of the Science Department, Classical High School, Providence, Rhode Island; and Mr. Kenneth Mairs, educational chairman of the Newport Engineering Society.

The prize winners included the following. Entrance prize for the school having the largest number of entrants in ratio to class members — the Henry F. Anthony School, Portsmouth, with a total of 85 entrants out of a class membership of 128, or 70%. First prize — Richard Barboza of Anthony School, Portsmouth, for his homemade microscope. Second prize — Colin Cambell, John Clarke School, Newport, for a homemade still for the distillation of water. Third prize — James Michael, Mumford School, Newport, for an electric weathervane. The three schools from which these students came were also awarded prizes.

ASIDE from the excellent cooperation shown by the teachers who contributed much time and effort, the important single factor in the success of the fair, was the active interest taken by the Superintendent, Dr. Walsh. It is always gratifying to receive the wholehearted support and cooperation of the school authorities. A most interesting sidelight is the fact that the boy who constructed the microscope which won first prize, comes from a home where no English is spoken. It is our hope that this interest, aroused in the grades can be sustained, and that the skills developed will enable these same youngsters to carry on projects of greater difficulty and originality on the high school level. We look forward to the hope of some of these young people entering the Science Talent Search within a few years.

BOOK SHELF

WORKBOOK IN ELEMENTARY METEOROLOGY. Frederick L. Caudle, M. S., State Teachers College, Oshkosh, Wisconsin. McGraw-Hill Book Company, New York City, 1945. 191 pp., 20x26 cm., 43 halftone illus. and a number of drawings. $1.24.

This workbook presents a very complete course in the study of weather. It contains both text material and exercises and is designed to be used either as a basic text supplemented by other reference material in the field, or as a study manual to give thought exercises to hasten learning of text material. Emphasis is placed on aviation.

There are forty-four units, each containing text maetrial and also exercises. Some units contain maps, graphs, and tables to be completed. A glossary of meteorological terms and meteorological tables is included.

CLIMBING OUR FAMILY TREE. Alex Novikoff. International Publishers, New York, 1945. 96 pp., 17x26 cm. $1.85.

This is an unusually outstanding and authoritative popularization of organic evolution, profusely decorated with cleverly drawn pictures, many in color, by John English. From the first sentence, where it opens like a mystery tale, to the end of the book, one is held spellbound. There is no slack in interest and humor. It shows evidence of sound educational principles, yet is pleasantly lacking in the pedantic text-bookishness of so many books on science. The reader finishes the book with intellectual stimulation by a scientific explanation of the origin and nature of the races of mankind, with an indication of man's potentially great future in social rather than physical evolution. Though produced as "A Young World Book," Novikoff's book will fascinate you as well.

WINGS AND WEATHER. A. L. Chapman, University of Texas; Raymond Fletcher, Jane Adams School, Longbeach, California; and C. C. Maxey, Bureau of Reclamation, U. S. Department of Interior. Pitman Publishing Corporation, New York, 1945. 188 pp. 15x23 cm. Illus.

Wings and Weather is a workbook in the field of meteorology. The usual material in this area is organized in twenty units, each of which is introduced by an overview and a list of texts useful as references or source material. Thought questions are then presented to cause the student to find the essential facts. These are followed by tests. Some attention is given to presenting the principles in terms of flight problems.

THE SOCIAL IMPACT OF SCIENCE: A SELECT BIBLIOGRAPHY. Morris C. Leikind, The Library of Congress. United States Printing Office, Washington, D. C., 1945. 51 pp. $.15.

This annotated bibliography was prepared at the request of Senator Harley M. Kilgore of West Virginia, chairman of the Sub-Committee on War Mobilization of the Committee on Military Affairs of the United States Senate.

Part I, Section A, lists the science bills in Congress since 1942 with a descriptive title and indicates their status. Section B lists other government publications pertaining to science.

Part II includes a list of books and pamphlets on the impact of science on society. In some cases the contents are indicated.

Part III lists articles in periodicals pertaining to this area.

Part IV is an appendix listing literature pertaining to the atomic bomb.

GET MORE OUT OF LIFE. Adrian J. Gilardi. Bruce Humphries, Boston, 1944. 192 pp. 13x20 cm. 12 illus. $2.50.

In this book an engineer attempts to express his ideas about a field foreign to his training, but about which he has formed some definite convictions from experience and from contact with others. For those who are interested, it is well worth reading.

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AUTHOR INDEX